MULTIMEDIA UNIVERSITY

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FINAL EXAMINATION

TRIMESTER 1, 2019/2020

TCI3121 – COMPUTATIONAL INTELLIGENCE
(All Sections/Groups)

12 October 2019
02:30PM – 04:30PM
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 3 pages (including cover page) with 4 structured questions.

2. Answer ALL questions. The distribution of the marks for each question is given.

3. Please write all your answers in the answer booklet provided.

Question 1

(a) Briefly describe and state the origin of the FIVE computational intelligence paradigms.

(5 marks)

(b) Fuzzy relations map elements of one universe to another universe through the Cartesian product of the two universes. The strength of the relation between ordered pairs of the two universes is measured with a membership function. Consider $R_1 \in X \times Y = \begin{bmatrix} 0.8 & 0.2 & 0.9 \\ 0.1 & 0.5 & 0.3 \\ 0.7 & 0.6 & 0.4 \end{bmatrix}$ and $R_2 \in Y \times Z = \begin{bmatrix} 0.5 & 0.8 \\ 0.3 & 0.9 \\ 0.2 & 1.0 \end{bmatrix}$ as the fuzzy relations of the universe of $X \times Y$ and $Y \times Z$ respectively. Compute the Max-Product composition of $R_1 \circ R_2$.

(3 marks)

(c) When is the situation where fuzzy logic will be successful, and when is the situation where fuzzy logic will not be successful?

(2 marks)

Question 2

(a) A fuzzy membership function is a curve that defines how each point in the universe of discourse is mapped to a membership value (or degree of membership) between 0 and 1.
  i.   How are the fuzzy membership functions found?   (2 marks)
  ii. Illustrate two different membership functions for the fuzzy set {"**Tall people**"}
                                                                        (2 marks)

(b) Illustrate and describe the steps of the Mamdani fuzzy inference process for *contrast* and *brightness* in image enhancement.   (6 marks)

Question 3

(a) List the FIVE steps of generic *Evolutionary Computation* procedure.

(5 marks)

(b) Describe the main concepts of Particle Swarm Optimization (PSO).

(2 marks)

(c) In K-means, hard assignment is used to assign input vectors to a cluster.
  i.   What is the problem of the hard assignment?
  ii. Provide a solution to solve this problem.
  iii. Which algorithm can be used to address this problem?

(3 marks)

Continued......

Question 4

(a) Given a training set D, explain how *Bagging* approach performs the training.

(3 marks)

(b) Given the following information of a Hidden Markov Model:
- Two hidden states of: Hot (H), and Cold (C)
- Three observed states: Small (S), Medium (M), and Large (L)
- Initial state distribution:

$$\pi = \begin{matrix} H & C \\ [0.6 & 0.4] \end{matrix}$$

- Transition probabilities:

$$\begin{matrix} & H & C \\ H & [0.7 & 0.3] \\ C & [0.4 & 0.6] \end{matrix}$$

- Observational probabilities:

$$\begin{matrix} & S & M & L \\ H & [0.1 & 0.4 & 0.5] \\ C & [0.7 & 0.2 & 0.1] \end{matrix}$$

Compute the following state sequences probability of Markov process given the observations: S, M, S, L.

(5 marks)

   i.   HHCC
  ii.   CCHH
 iii.   HCHC
 iv.   CHCH
  v.   HCCH

(c) Atari games have been widely used to test the reinforcement learning. List out the objective, state, action, and reward of reinforcement learning used in Atari games.

(2 marks)

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